

present inland (4), but a cool change is expected on the west and southwest coast (4), which will gradually extend throughout (4).

The figures (1) and (2) are very seldom used, and then only as above, to indicate just a bare possibility. The figure (3) is occasionally employed for the main forecast, but the general practise is to use either (4) or (5) for the principal weather feature whenever possible, and this has been found practicable on most days. Whenever there is any serious doubt the figure (3) is used.

Great care is taken as to the figure (5). We wish to establish the utmost confidence in predictions followed by this figure and are therefore inclined to be rather conservative in its use. It has, however, been found possible to issue 685 such confident predictions for the two principal districts during the year, and of these 675 were justified by subsequent events.

As our weather comes mainly from the westward, where there are no observing stations, the period for which the prediction is issued is limited to 24 hours.

Two forecasts are issued daily (except Saturday and Sunday) for the Southwest and Goldfields districts, and the following shows the success or otherwise of the new system.

	Southwest district.			Goldfields district.	
	Right.	Wrong.		Right.	Wrong.
Weight 5.....	425	5	Weight 5.....	240	5
Weight 4.....	573	38	Weight 4.....	337	22
Weight 3.....	131	38	Weight 3.....	102	25
Weight 2.....	24	18	Weight 2.....	13	11
Weight 1.....	6	5	Weight 1.....	5	3

NOTE BY PROF. E. B. GARRIOTT.

For the limited areas covered by our forecasts by States this scheme would be impracticable, (1) for telegraphing our forecasts, owing in part to the great number of words and consequent expense that would be involved in transmitting them; (2) for forecast cards, that would not contain them; (3) for maps, that have not sufficient space to print them; (4) for the reason that the bewildering complication of uncertainties it involves would confuse even the patient interpolator; and (5) because our public insist upon having our forecasts expressed concisely and in unequivocal terms. For general forecasts, that apply to the country as a whole, our present vocabulary can, if properly employed, be made to cover all necessary modifications.

THE RELATION OF FORESTS TO RAINFALL.¹

By the late W. F. HUBBARD.

[Communicated by Mr. Geo. B. Sudworth, Chief of the Division of Dendrology.]

The relation between forests and rainfall is very complex. It is claimed that the presence or absence of forests may increase or diminish precipitation to some extent, especially in semiarid regions.

On the other hand, forests are dependent upon moisture, and, other things being equal, the densest forests are found in regions of greatest rainfall. It is not the total precipitation of the year that favors vegetation (field crops as well as forests), but the amount that falls during the growing season. Thus a locality may have thirty-five inches of rain annually, but

if most of it falls in heavy showers or during the winter, some trees and crops will flourish less than where an annual average of but twenty inches is made up largely of moderate spring and summer rains. Trees are more dependent upon uniformity in the rainfall than the field crops, for if a severe drought comes but once in five years the trees may be killed. It is also true that a crop of grain may be destroyed by the drought, but that is a loss of only one season's growth whereas in the case of the trees it is a loss of the growth of many years. In general it is found that a region having less than fifteen inches of rain during the six growing months, April-September, does not support flourishing forests; trees may grow along the streams and where they are cultivated, but the real forest will be absent.

As rainfall determines the presence or absence of forests, so the configuration of the land and its relation to water bodies and constant winds determine the rainfall. These relations and their effects can be traced in all forest regions of the United States, but they are so clear in the western half of the country that that section may be taken as a type. It should be remembered that moisture is carried in the atmosphere, and that when an air current is forced to rise, as when it meets a mountain range, the air expands, is cooled, and precipitates its moisture first as cloud and then as rain. When a current descends, as from the crest of a mountain, the process is reversed; that is, the air is compressed, warmed, and made retentive of moisture or even capable of absorbing more water from any available source. The western coast line of the United States includes a great curve with the crown of the arc at Cape Mendocino. The rain bearing winds are the west or north-west winter winds. They are also much more constant over the northern half of the coast line than over the lower or southern half, since the latter falls within the region of subtropical calms. All these conditions combine to determine the character of the forests throughout the West and explain why they are dense on the Pacific coast, and on the western slopes of the Sierras and the Rocky Mountains, and why they dwindle on the eastern slopes and fail entirely on the plains.

The accompanying map and profile of California illustrate this subject very thoroughly, because every feature of forest distribution is to be found within this State. The westerly winds striking the Coast Range have their moisture condensed as fog in summer and rain or snow in winter; here are the heavy redwood forests. Passing the summit of this range the winds descend and become drier and drier, finally reaching the great interior valley where no trees grow. Then mounting the western slope of the Sierras the winds expand and cool and rain falls. The increase of moisture is marked by the transition from chaparral to open pine forests, then to denser forests of fir, spruce, sugar pine, and the great sequoia. The upper timber line is at about 10,000 feet; for various reasons no trees grow on the higher summits, but not because of deficient moisture. Passing the summits, the winds again descend to the plains, but they have lost so much of their moisture² in crossing two mountain ranges that on the

² The air does not lose much moisture in coming over the California mountains, probably not one per cent; but it does lose many per cent in relative humidity.

From another point of view, however, one may say that, on the windward side of our Coast and Sierras ranges, there are more clouds than on the leeward side, consequently the soil and roots do not become so hot at midday, and especially does foggy weather keep them cool; this coolness is quite as important to the growth of a forest as high relative humidity or abundance of rain. In fact if one follows along the course of any one of the belts of forest growth he will find it running over various elevations and rainfall areas in such a way as to show that these two are not alone the controlling factors.

It would increase the value of such charts of the distribution of forests if something could be added as to the species of trees characteristic of the forests. It seems hardly sufficient to say that a dense forest prevails in a certain rainfall region, but a light forest in another rainfall region. Is not the species of tree as important as the density of the forest?—EDITOR.

¹ This paper consists essentially of a large chart of California, showing in detail the distribution of rain and forests in that State. The chart and accompanying text were prepared by the late William F. Hubbard, of the Bureau of Forestry, for exhibition at the Lewis and Clark Exposition held at Portland, Oreg., in 1905. Unfortunately Mr. Hubbard was drowned on July 17, and the text must, therefore, be published without his final revision. The chart represents the work of a very enthusiastic student, and we regret that, owing to the limitation of our space, we are unable to publish the whole of the chart, which is based upon all available reliable data, and affords a basis for many generalizations that the author would doubtless have elaborated had his life been spared.

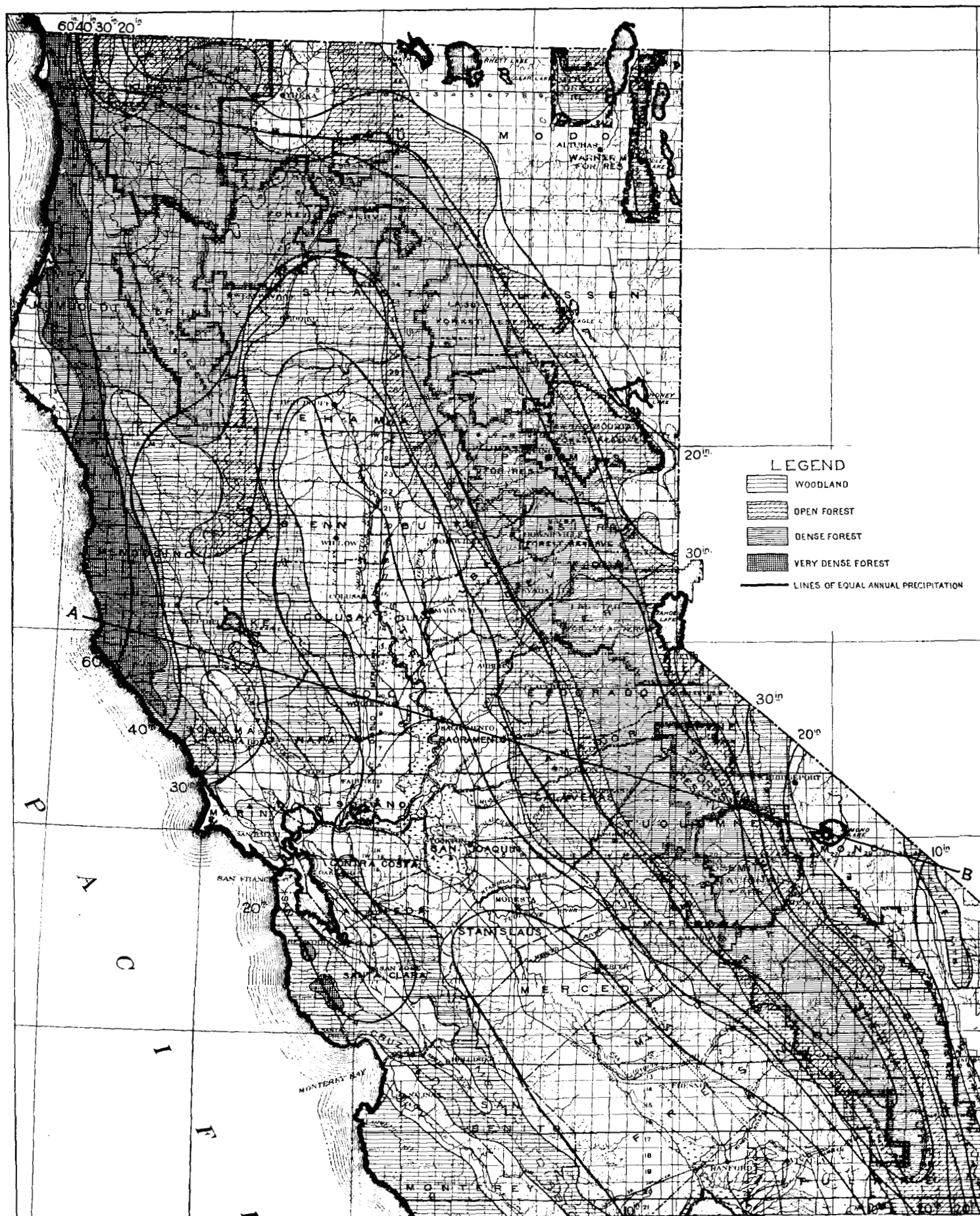


FIG. 1.—Distribution of annual rainfall and forests.

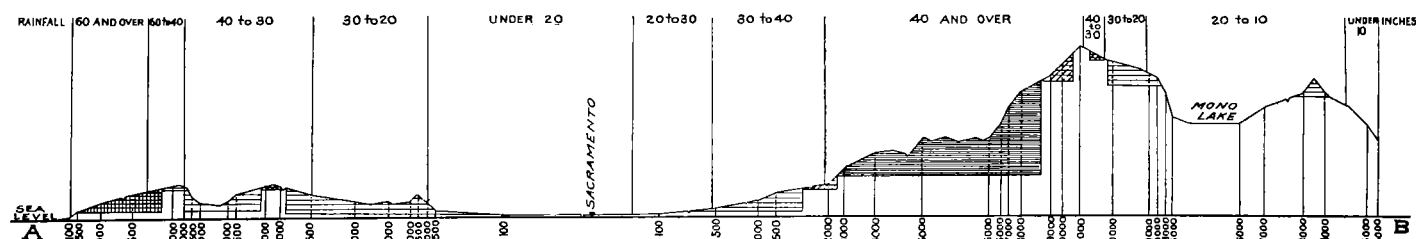


FIG. 2.—Profile along the line A B.

eastern slopes forests flourish for only a short distance below the 10,000-foot timber line. Then comes chaparral, and finally the desert. The latter extends far beyond the borders of California to the outlying ranges of the Rockies.

Thus topography and winds are the controlling factors in the distribution of forests. They make most of the Pacific coast a region of winter rains and summer droughts, and, away from the coast, limit the forests to the higher altitudes.

AN IMPORTANT OLD LOCAL WEATHER RECORD FOR PHILADELPHIA, PA.

Mr. John W. Dulles, President of the Insurance Company of the State of Pennsylvania, which was founded in 1794, states that the company has what appears to be a continuous and admirable record of the temperature, wind, and weather at Philadelphia, kept up for over 50 years, beginning with May, 1806. The following table is sent by Mr. Dulles as a sample page. Without having any further detailed information about this record, we need only call attention to the fact that whenever such records have been published in full,

with appropriate notes and discussion, they have been recognized as important contributions to our knowledge of local climatology, and have often been made the basis of further studies relative to insurance, crops, hygiene, and other practical matters. The local climatology is a matter that interests respective cities and States, and there is no propriety in the idea that the Federal Government or the general Weather Bureau should undertake publications that have mostly a local interest. Two famous records of this kind were published by the Smithsonian Institution in order to show how such work should be done. Possibly some great work of the kind may be encouraged by the Carnegie Institution, but we ought more properly to look to the wealthy men of Philadelphia to support its own local scientific institutions, such as the famous American Philosophical Society, founded by Benjamin Franklin in 1741. This society has always shown a great interest in meteorology, and should be honored by the gift of funds for publishing and discussing such a fine, long series of records as that which is now locked up in the archives of the insurance company.

January, 1807.	Wind.			Weather.			Degrees of heat and cold.				Remarks.
	A. M.	M.	P. M.	A. M.	M.	P. M.	A. M.	M.	P. M.	Mean.	
1.....	n.	n.	s.	Clear	Clear	Clear	23	24	25½	24	Sharp frost. Frost. Last night rained a littel and froze this mornen, which rendered walken extremely dangerous.
2.....	sw.	sw.	sw.	Cloudy	Cloudy	Cloudy	26½	28½	30	28½	
3.....	sw.	nw.	nw.	Fling clouds ..	Light clouds ..	Fling clouds ..	32½	33½	34½	33½	
4.....	sw.	sw.	sw.	Clear	Clear	Clear	32	33	34	33	Frosty.
5.....	sw.	s.	sw.	do	do	Light clouds ..	34	35½	38½	35½	
6.....	sw.	w.	w.	Hazy	Fling clouds ..	Clear	41	42	42	41½	
7.....	sw.	sw.	w.	Cloudy	Cloudy	do	40	40½	41	40½	Severe frost, with the navigation of the river shut.
8.....	w.	nw.	nw.	Clear	Fling clouds ..	Fling clouds ..	37	37	37½	37	
9.....	sw.	sw.	sw.	do	Clear	Clear	33	33½	36	34	
10.....	s.	s.	s.	Cloudy	Cloudy	Cloudy	33½	34½	36	34½	Thaw.
11.....	sw.	w.	w.	do	Fling clouds ..	Fling clouds ..	36	37	37½	36½	
12.....	n.	nw.	nw.	Clear	Clear	Clear	35	34½	34½	34½	
13.....	nw.	nw.	nw.	Cloudy	Fling clouds ..	do	28	27½	27	27½	This day very wet, afternoon very foggy and dense.
14.....	sw.	w.	w.	Clear	Clear	do	23	23½	25½	24	
15.....	sw.	sw.	sw.	Cloudy	Cloudy	Cloudy	32½	34	35½	34	Thaw.
16.....	nw.	sw.	sw.	Fling clouds ..	Clear	Fling clouds ..	36	37	38½	37	
17.....	nw.	nw.	nw.	do	Fling clouds ..	do	32	32½	33	32½	
18.....	n.	n.	n.	Snow	Snowy	Snowy	32	32	31½	31½	Thaw.
19.....	nw.	nw.	w.	Clear	Clear	Clear	21	21½	23	21½	
20.....	sw.	sw.	sw.	do	do	do	18½	19½	22½	20	
21.....	wdw.	nw.	dw.	do	do	do	24½	26½	28	26½	Thaw.
22.....	nw.	nw.	nw.	do	Hazy	do	25½	26½	28	26½	
23.....	ne.	ne.	se.	Cloudy	do	Fling clouds ..	24½	25	27½	25½	
24.....	sw.	nw.	nw.	do	Cloudy	Cloudy	31	32½	34	32½	Thaw.
25.....	w.	nw.	nw.	Clear	Fling clouds ..	Clear	31	31½	31	31½	
26.....	nw.	nw.	nw.	do	Clear	do	22	22	22½	22	
27.....	ne.	ne.	se.	Hazy	Hazy	Hazy	21	24	27½	24½	Thaw.
28.....	s.	s.	se.	Cloudy	Cloudy	Clear	39	41	42½	40½	
29.....	sw.	w.	w.	Light clouds ..	Light clouds ..	do	39½	41	42½	41	
30.....	sw.	nw.	sw.	Clear	Clear	do	39½	40	41½	40½	Thaw.
31.....	de.	se.	s.	Rainy	Rainy	Rainy	39	40½	42	40½	

NOTE—Fling clouds = flying clouds.—EDITOR.

RECENT ADDITIONS TO THE WEATHER BUREAU LIBRARY.

H. H. KIMBALL, Librarian.

The following titles have been selected from among the books recently received, as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies. Most of them can be loaned for a limited time to officials and employees who make application for them.

American Association for the Advancement of Science.

Proceedings of the fifty-fourth meeting, held at Philadelphia, Pa., December 27-31, 1904. 620 pp. 8°. [Washington] 1905.

Biot, [Jean Baptiste].

Recherches sur les réfractions extraordinaires qui ont lieu près de l'horizon. 268 pp. 4°. Paris. 1810.

Carnegie Institution of Washington.

Year Book. No. 4, 1905. 4°. Washington. 1905.

Clayden, Arthur W[illiam].

Cloud studies. xiii, 184 pp. 8°. London. 1905.

Costa Rica. Instituto Fisico-Geografico Nacional.

Anales. Tomo IX. 1896. f°. San José. 1896.

Gockel, A[ibert].

Das Gewitter. 264 pp. 8°. Köln. 1905.

Lausanne. Institut Agricole de Lausanne.